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Continued Development of Open Seismic Hazard Analysis (OpenSHA) in Support of a Community Modeling Environment for Seismic Hazard Analysis

Collaborative Research between University of Southern California and
the United States Geological Survey

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Introduction

This report describes work on *OpenSHA* performed by Nitin Gupta in 2007 with NEHRP support. *OpenSHA* (www. OpenSHA. org) is open source, object-oriented (modular), multiplatform, web accessible, and graphical user interface (GUI) enabled. The framework allows any arbitrarily complex (e.g., physics based) earthquake-rupture forecast, ground-motion, or engineering-response model to "plug in" for analysis without having to change what's being plugged into. Furthermore, any of the data or modeling components can be deployed and accessed from anywhere over the internet using distributed object technologies (Field et al., 2005a; Maechling et al., 2005a). We are also using GRID computing at access idle computers in order to expedite large computational problems (Field et al., 2005b; Maechling et al., 2005b).

The goal of this infrastructure is to reduce the gap between cutting-edge geophysics and state-of-the-art hazard and risk evaluations. The plug and play nature of this community modeling environment is necessary because determining the implication of a new model component, say a new earthquake rupture forecast, will depend on several other factors including: the exact location of interest; the type of intensity measure one is concerned about; what ground motion model one selects; site conditions; etc. Without being able to easily change such parameters, one will not be able to fully evaluate hazard or loss implications. Furthermore, the often-stated goal to build a more physics-based foundation for SHA will not be successful unless we provide the tools necessary for the user communities to easily access the models (because practitioners won't be able to re-implement physics based models themselves).

Currently available applications include (available at the OpenSHA web site noted above):

- Hazard Curve Calculator
- Scenario ShakeMap Calculator
- Hazard Map Data Calculator
- Hazard Map Plotter
- Hazard Spectrum Calculator
- Attenuation Relationship Plotter
- Mag. Freq. Dist. Plotter
- SCEC VDO plug-ins
- Fault Section Database GUI
- PaleoSites Database GUI
- Event Set Data Calculator
- HAZUS PSHA Dataset Calculator

Some Notable accomplishments during the funded year include:

- Implementation of the preliminary NGA models

- Implementation of the UCERF 1.0 of the Working Group on California Earthquake Probabilities (see the Working Group on California Earthquake Probabilities web site www. WGCEP .org)
- Implementation of site-specific attenuation relationships (in collaboration with Jon Stewart's group at UCLA)
- Implementation of a full PSHA interface to HAZUS (in collaboration with Hope Seligson)
- Collaboration with, and providing access to, CyberShake's 3D-waveform-based PSHA. These are full hazard calculations using 3D synthetics!! (in collaboration with Phil Maechling of SCEC and Rob Graves of URS, Inc.)
- GUI-based tools for viewing and managing the Oracle-based California Reference Geologic Fault Parameter Database of the WGCEP (see the Resources section of the WGCEP web site, specifically fault VisTools)
- Implementation of an Event Set Data Calculator for loss analysis (in collaboration with Keith Porter of the University of Colorado at Boulder and Nico Luco of the USGS). This was used by a southern California utility to make multi-million dollar decisions
- Development of OpenSHA plug-ins for SCEC VDO (in collaboration with SCEC interns)
- Full Java implementation of the USGS Short Term Earthquake Probability (STEP) aftershock hazard maps (in collaboration with Matt Gerstenberger of New Zealand GNS Science)
- USGS NSHMP application giving engineers access to Seismic Design Values for Buildings (in collaboration with E.V. Leyendecker, USGS Emeritus; information available from the USGS web site with a search for Seismic Design Values)
- Progress on code documentation, including an OpenSHA Glossary (available under Documentation on the OpenSHA web site); tutorials (available under Documentation on the OpenSHA web site); and documentation of the Java code for OpenSHA (available under Java Source Code on the OpenSHA web site).

References

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